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EXTENSION WORK IN AGRICULTURAL ENGINEERING, 1923

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INTRODUCTION

An outstanding feature of extension activities in agricultural engineering in 1923 was the wide range of subjects covered. About 20 more or less distinct lines of work were reported on by extension specialists, including such rather unusual subjects as lime burning, sewing-machine schools, farmstead planning, and radio. Several new phases of agricultural engineering were taken up during the year, indicating a rapid expansion in this field. The year's work shows, beyond a doubt, that agricultural engineering now occupies a place of prominence in rural life comparable with animal husbandry, home economics, agronomy, and other important phases of extension work. The agricultural engineer aids in bringing farm land to a higher state of production by drainage, terracing, irrigation, and clearing of stumps and bowlders. He makes farm life more enjoyable, attractive, and healthful by showing the farmer how to install modern plumbing, electric lights, septic tanks, and heating plants. He helps to increase the profitableness of livestock and poultry by designing and furnishing plans of properly ventilated farm buildings, and by encouraging the erection of silos and the use of self-feeders. He is a factor in prolonging the life of farm machinery and farm buildings by teaching their proper care and repair.

For the fiscal year ended June 30, 1923, extension work in agricultural engineering was reported from 29 States. Including part-time workers, a total of 40 rural-engineering specialists were employed by the extension divisions of the States, and the funds expended for such work amounted to $177,600. A large part of the work was done in cooperation with county extension agents. The small number of specialists engaged in rural-engineering activities could have accomplished only a fraction of the work done had it not been for the aid of county extension agents. The accomplishment in rural-engineering extension is indicated in Table 1, which was compiled from reports of county extension workers.

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TABLE 1.—*Some statistical results of rural-engineering extension, 1923*

	Number
Farms installing drainage systems	5,396
Acres drained	467,600
Farms installing irrigation systems	1,194
Acres irrigated	40,182
Farms constructing terraces or soil dams	21,028
Acres on which soil erosion was so prevented	684,157
Dwellings constructed according to plans furnished	1,749
Dwellings remodeled according to plans furnished	2,203
Sewage-disposal systems installed	2,322
Water systems installed	3,191
Heating systems installed	964
Lighting systems installed	4,654
Farms on which buildings other than dwellings were constructed or remodeled according to plans furnished	24,497
Buildings so constructed or remodeled:	
Barns	3,211
Hog houses	4,608
Poultry houses	15,167
Silos	1,550
Other buildings	2,262
Farms assisted in the care and operation of machinery, including tractors, power sprayers, and milking machines	9,437
Farms clearing land	33,449
Acres of land cleared	249,205

DRAINAGE

Drainage took first rank among engineering extension activities, although the agricultural depression noticeable in 1922 was still a handicap in the carrying out of drainage projects. For this reason farmers in many sections were more favorably inclined toward the construction of open drains than of tile drains. As one engineer stated, "The farmers still want drainage, but the installation must come within their means." Work in farm drainage is not confined to any particular section of the country, drainage projects forming a part of the program of nearly every State extension service which employs a specialist in agricultural engineering.

That there is still great need for extension in drainage is shown by the following statement from the New York report:

> In the past, drainage has been our most important extension activity in agricultural engineering, due to the fact that New York has approximately 500,000 acres of muck and marsh lands in relatively small, widely scattered areas and approximately 12 times as many acres of upland under cultivation that would be greatly improved by underdrainage. * * * In view of the present low scale of farm prices, the high wage scale, and the large number of one-man farms in the State, it is advisable, where possible, to drain wet spots so as to increase as much as possible the production per man.

In several States, in addition to the assistance rendered individual farmers, drainage districts were organized for the purpose of planning and constructing systems to serve an entire community. Extension divisions of some States were assisted in such work by drainage engineers from the United States Department of Agriculture.

Evidences of the beneficial effects of drainage continue to multiply. A farmer in Kentucky reported that he grew 50 bushels of corn per acre on drained land that he had previously considered worthless. An adjoining undrained field produced only 12 bushels per acre, although 50 pounds per acre more fertilizer was applied to the undrained than to the drained land. In Virginia the value of drainage demonstrations, based on the increased production from the area drained during the year, was estimated to be more than $50,000. A farmer in Washington reported that before his land was drained he could keep only 14 cows, whereas after drainage was completed he kept 25 cows on the same area. Another man in the same State asserted that drainage had doubled his yield of oats. Another stated that his lowland, which before drainage did not pay for the seed, is now the most valuable part of his farm.

It is not the function of the extension specialist to teach individual farmers how to drain their land, but rather to demonstrate that the increased production from drained land will amply pay for the improvement. Accordingly, the method usually followed is to plan a drainage layout for a representative farm and superintend the construction of the drains (fig. 1). Meetings are held on the farm during the course of construction, and the principles of correct drainage are explained. Having had their attention thus focused on the enterprise, farmers in the community naturally will watch the results with keen interest. If results are favorable, the demonstration will usually be followed by increased activity in drainage and possibly by the organization of a drainage district to embrace the entire community. In Kentucky, after the value of farm drainage had been established, a district was organized and a dredged ditch 15 miles long constructed for surface drainage.

PREVENTION OF EROSION

Of equal importance with drainage is the subject of prevention of soil washing or erosion through the building of terraces and soil-saving dams, contour farming, and the growing of

leguminous crops. The greatest need for terracing seems to be in the Central States of the Mississippi Valley. Illinois reported that soil erosion causes great loss of fertility on many farms and that more than 5,500,000 acres in the State are being seriously eroded, part of this area having been abandoned. Consequently, 16 counties in Illinois asked for aid in 1923 in combating erosion.

Wherever terraces have been built and properly maintained the results have proved highly beneficial, although one specialist cautions against "overselling the farmer" on terracing, since nothing can be gained by inducing farmers to terrace land where the benefits derived are not equal to the cost of improvement. For this reason great care should be used to select, for demonstrations, farms that are plainly in need of terracing.

In one county in Oklahoma the county agent assisted in terracing 4,000 acres, which he estimated increased the land value $5 per acre, or a total increase of $20,000. The Oklahoma terraces were subjected to severe tests in 1923 due to unusually heavy rainfall, as much as 16 inches in 24 hours having fallen in some localities. Where the terraces were properly constructed, they usually were undamaged. Most of those that were destroyed were promptly rebuilt by the farmers.

In Iowa 20 acres were terraced and planted to corn. Before the corn was up the field was subjected to a heavy rain but was undamaged. The owner was satisfied that the damage averted during this one storm was sufficient to pay for the work of terracing the field.

Two general methods of teaching terracing that have been followed are (1) demonstrations, and (2) terracing schools or short courses. The demonstrations consist of actually laying out a field for terraces and supervising their construction. The specialist explains the principles and methods as the work progresses (fig. 2). Following is an account of a typical terracing school or short course taken from the Tennessee report:

FIG. 1.—Demonstration farm-drainage system under construction. The grade is tested by use of a grading line and rod. At different intervals during the construction of such demonstration drainage systems, meetings are held during which the principles of correct drainage are explained. Reports of county extension agents show that 5,396 farmers were influenced to install drainage systems in 1923

Seven news articles calling attention to the school were sent to the county agent for the county papers a month in advance. Later a sheet plan showing the duties of the agent, specialist, tractor dealer, ditcher representative, and farmer were sent to the agent, followed by 50 placards calling attention of the farmers to the free terracing school. About 2,000 mimeographed sheets, giving three crop rotations, suggestive temporary and permanent pasture crops, two methods of preparing land for alfalfa, and the plow method of building the Mangum terrace, and a number of bulletins were placed in the hands of the agent to hand out during the meetings.

The morning sessions were devoted to lectures and instrument work and the afternoons to practical demonstrations. The blackboard was used in explaining the reasons for terracing, the importance of controlling water, and the value of humus. * * * The afternoons were used entirely to show the methods of building terraces. * * * On the third day an examination was given. Attendance at the schools ranged from 6 to 35 in the mornings and averaged 65 in the afternoons.

Some schools have held night sessions, at which motion and still pictures were shown to illustrate the methods employed. Instructions have also been given for making terrace drags and for using farm levels and level rods.

portance of this phase of agricultural-engineering activities.

Farmers have been assisted largely through the preparation and distribution of standard plans for buildings and farmsteads and occasionally by demonstrations. Usually the plans have been distributed free of cost, but in some places a small charge has been made. In many States it has been difficult to maintain a follow-up system to enable the extension specialists to determine to what extent the plans have been carried out.

In Ohio it is the aim to build a model poultry house in each county.

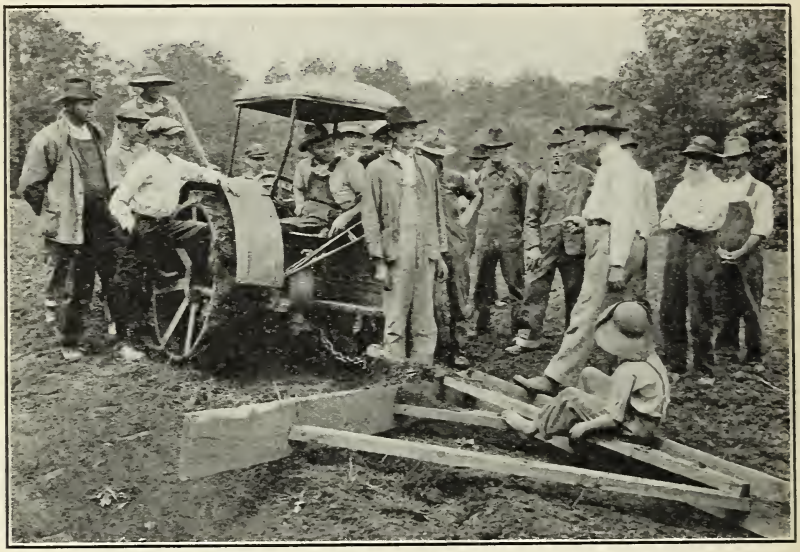

FIG. 2.—A terracing demonstration. The extension rural engineer supervises the construction of terraces on a field and explains the principles and methods as the work progresses. Largely as the result of such demonstrations, more than 21,000 farmers constructed terraces or soil dams in 1923, which prevented erosion on 684,157 acres of land

FARM BUILDINGS

Under this head are included such subjects as plans for the construction of dwellings, barns, poultry and hog houses, and other farm buildings, farmstead planning, ventilation of buildings, and painting and other preservative treatment. It is estimated that Illinois farmers are spending $100,000,000 on the construction and maintenance of farm buildings each year. The extension specialist in Kansas estimates that the depreciation on farm buildings in that State amounts to $12,000,000 annually. Since a considerable portion of such losses is preventable, these figures indicate the im-

In order to accomplish this end, poultry-house building demonstrations have been conducted in the same manner as barn raisings (fig. 3). Poultry houses built at such demonstrations were practically completed in one day. In conducting such a demonstration, the county agent selected the farm upon which a poultry house was to be constructed and assisted the farmer in choosing the type and size of house to be erected. Sufficient publicity was given the project to insure the presence of 10 or more farmers. The house was not to be larger than 25 by 30 feet, as larger houses could not be completed in one day. The foundation and framework were usu-

ally built prior to the time of the raising in order to allow sufficient time for the farmers to build nest racks, mash feeders, perches, and other interior fixtures. A noonday lunch usually was served by the farmers' wives. In the evening when the house was practically completed the specialist explained its details and special features, such as proper lighting and ventilation, and bulletins giving plans of the house and fixtures were distributed.

In one county in North Carolina a paint campaign was carried on in 15 townships by the county agent in co-

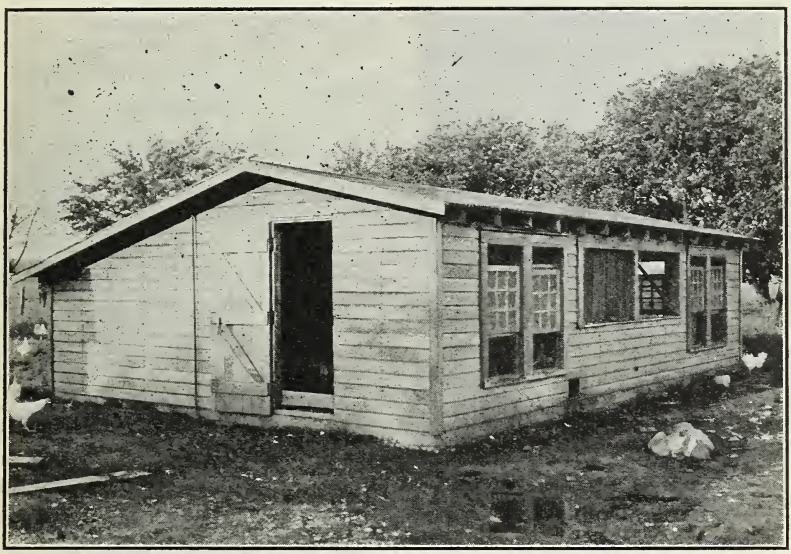

FIG. 3.—Model poultry house used in Ohio. The extension service plans to erect such a poultry house in each county in the State. A building demonstration, attended by 10 or more neighboring farmers, is held on a selected farm, and the house is practically completed in one day. During 1923, on farms throughout the country, 15,167 poultry houses were constructed or remodeled according to plans furnished by the extension service

operation with local paint dealers and paint manufacturers. Two hundred gallons of paint donated by manufacturers and $60 in cash donated by dealers were offered as prizes. As a result, 210 farmers agreed to paint the outside of their homes, 178 to paint the inside, 52 to paint barns and other outbuildings, and 44 to paint farm machinery.

FARM-HOME CONVENIENCES

The percentage of farm homes equipped with modern plumbing is still low. The great majority of rural homes have progressed no farther than having a pitcher pump on the back porch or at the kitchen sink, and outdoor toilets are still common. The aim of extension specialists in agricultural engineering has been to convince farmers that such conveniences as running hot and cold water, kitchen sinks, and indoor toilets can be provided in the house at small cost (fig. 4). A typical illustration of what may be accomplished when the farmers' attention is directed to this matter in a convincing way is contained in the following report from Virginia:

A visit was made to the Jones home in company with the home demonstration agent. Mr. Jones stated that he did not have the time or money to install a water system. However, permission was given to make a survey, and it was found that Mrs. Jones had been walking a minimum of 115 miles per year and had carried 72,000 pounds of water in that time, lifting approximately 200 pounds each day a height of 60 feet. When presented with these facts and given an estimate of the cost of a water system Mr. Jones decided to put in a system as recommended. A later visit showed that he had followed instructions and had constructed a 7,500-gallon concrete cistern and pitcher pump for furnishing running water to the kitchen. Other home conveniences, such as lighting and heating plants, have since been installed.

At the State fair in Kentucky a cheap but efficient water system was exhibited which could be built for $65, or as one of the placards stated, one-

seventh of the price of an inexpensive touring car. Along with the exhibit was a mechanical device which represented an old woman walking from the house to a pump in the yard, filling a pail with water, and returning.

In California, in addition to water-supply demonstrations, water-supply schools were conducted, as follows:

> Two types of work were given, the lecture demonstration and the installation demonstration. Demonstration equipment was carried on a truck. It consisted of a small pressure pump which could be operated either by hand or with the engine used to drive the electric generator, a small pressure tank, fittings, pipe, hose, tubes, and pipe-fitting tools. Where one full day was given to the lecture demonstration a short talk was given by the specialist on the units of a farm water-supply system. After this lecture the audience helped to set up the pressure and the gravity systems for the units carried on the truck. This gave the men an opportunity to practice pipe fitting and to become familiar with the parts of a water-supply system. Where the school was for only half a day or for an evening the specialist set up most of the equipment before the meeting. The set was then used during the discussion to illustrate the lecture, showing different water-supply systems, power required, pressure, size of pipe, and approved installations.

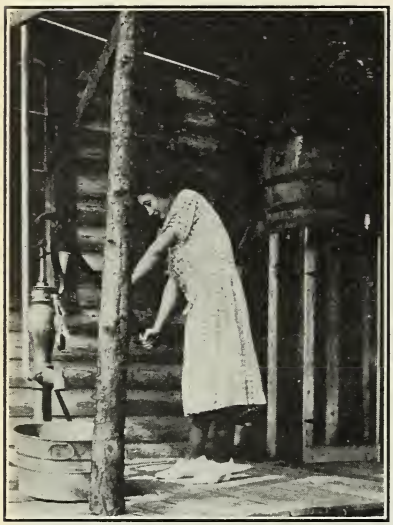

FIG. 4.—An inexpensive water system that saved many steps in a farm home. The materials consisted of 20 feet of pipe, a wooden barrel, and a faucet. County extension agents reported that 3,191 water systems were installed in farm homes during 1923 as a result of extension effort

The installation demonstration differed from the method described above chiefly in that an actual installation was made at a farm home. The first thing done at the school was to go over the proposed installation with those present so that all would understand what was to be done. The system was then installed, each operation being explained as the work progressed, and the lines were tested under pressure as soon as installed.

Installation of septic tanks to take care of house sewage and kitchen waste was taught both by demonstration and by the distribution of standard plans. In a number of States surveys were made to determine the feasibility of installing hydraulic rams, hydroelectric plants for farm power and lighting, or lighting and power systems using commercial current. After the surveys were made plans and estimates were submitted to the farmers.

IRRIGATION

The States reporting activities in irrigation extension are California, Colorado, Kansas, Nebraska, Oklahoma, and Washington. The phases of the subject emphasized in these States differed according to local demands. For instance, in Oklahoma and Nebraska the phase emphasized was conservation of flood water by impounding it in reservoirs; in Kansas, development of pumping plants; in Utah, consolidation of small irrigation systems and the control of gravel; and in California, the study of soil moisture and more economical use of water.

A field meeting advertised as "irrigation day" was held in a number of localities in California. The manner of conducting such meetings is described in the following report:

> The head of the division of irrigation investigations and practice and one of the assistant State leaders of farm advisers took active part in the program. The events of the meeting were:
>
> (1) An inspection of efficiency of furrow irrigation with water run in different sets of furrows for different lengths of time.
>
> (2) A determination of the depth of penetration in check or basin systems of irrigation with measured amount of water applied.
>
> (3) A test of penetration of water in basins, known depths being applied to a series of basins and depth of penetration per inch of water applied determined for particular soils.
>
> (4) A determination of the time of irrigating border checks by varying the head used. Water was run in one set of furrows for about 8 hours; in a second set, 12 hours; and in a third set, 24 hours. Where soil conditions required, greater or lesser time of runs were used, but the ratio between lengths of run was usually kept at 8:12:24. Furrows were cross-trenched (about 24 hours after water was turned off) down to the depth of penetration of the irrigation water and the wetted area outlined.

LAND CLEARING

The year was one of great activity in land clearing in a number of States, especially in Michigan, Minnesota, North Carolina, Oregon, Washington, and Wisconsin. This was due largely to the vigorous campaigns put on in the various States to dispose of surplus war explosives known as picric acid and sodatol. The surplus supply of picric acid turned over to the United States Department of Agriculture has been entirely disposed of, and plans for the distribution of sodatol have been completed.

Two methods were followed in Wisconsin for demonstrating the use of explosives in removing stumps. The method most frequently followed was to select a field containing stumps or bowlders, or both if possible, and go through the operations of loading, tamping, and firing the charge, explaining each step in the process to the assembled farmers. The farmers were encouraged to ask questions and make suggestions as to methods, size of charge, and the like. Usually a second stump or bowlder was blasted by the use of a different method of loading and firing.

The second method consisted of land-clearing demonstration meetings. Farmers of a locality signed up in advance to do the work of stump blasting themselves for one day under direction of the extension specialist. At some meetings, several acres of land were cleared in a single day when the crowd was large enough to be divided into several crews. In all stump-blasting demonstrations the safety provisions were strongly emphasized.

The land-clearing specialist of Wisconsin reported as follows:

> It was found that the cut-over district was largely overstocked to the extent that high-priced rough feeds were being purchased in very large quantities with long freight hauls. At the same time the farmer was paying carrying charges on idle land within a few rods of his door. This condition furnished a basis on which the campaign for the use of low-priced explosives was made.

It was found in Wisconsin that the total cost of clearing, including labor, material, and equipment, averaged from $40 to $50 per acre, although ranging all the way from $10 to $75 or $100. By using surplus war explosives the cost was reduced $2 to $5 per acre. Although this is relatively a small part of the total cost, it represents a cash saving most acceptable to the farmer.

FIG. 5.—Pulling a small stump with a Paul Bunyan hammer at a land-clearing demonstration. At such demonstrations a tract of land is cleared of stumps, plowed, and planted in a single day to show farmers the proper methods of preparing unused land. During 1923, 249,205 acres of land were cleared on 33,449 farms. (Photograph furnished by Michigan Extension Service)

In southern Wisconsin and in several Southern States the chief aim of land-clearing extension was not so much to increase the number of farms as to increase the productivity of existing farms and the efficiency of farmers. This was done by encouraging the removal of isolated stumps from cultivated fields and of small groups of stumps at the edges of fields, which greatly retard plowing, cultivating, and harvesting. The Wisconsin extension specialist expressed the opinion that the resulting increase of efficiency in the use of land was of more value than the actual increase in cultivated acreage.

A goal of 5 acres cleared per farm, or a total of 60,000 acres, was set for the year in the Upper Peninsula of Michigan. Although the area actually cleared fell somewhat short of this mark, it represented a large increase over the rate at which clearing had progressed before the campaign started.

The method followed in the Upper Peninsula consisted of land-clearing demonstrations conducted with special equipment hauled from place to place on a motorized train (fig. 5). The equipment consisted of a truck, a light automobile, a tractor and trailer, dynamite and picric acid, two hand stump pullers, a horsepower stump puller, blasting tools, a Paul Bunyan hammer, scissors, stone boat, Frost trip for piling stumps, a specially designed root hook, an A-frame, and a breaking plow. Farmers were found to be most interested in explosives, homemade clearing equipment, tractors, and tractor plowing. Only a small tract was cleared, the aim being to clear completely and if possible plow and plant the tract in a single day. In this way the farmers were enabled to witness the entire process of land clearing. It was believed that each farmer who attended took home some ideas which would be of benefit to him in the more complete utilization of his farm land.

In the Lower Peninsula, a specially equipped car lent by one of the railroads made a tour of the northern counties and held 39 meetings, beginning February 19 and ending April 10, at which four or five reels of motion pictures of land-clearing operations were shown, supplemented by talks on land clearing. In all, 2,105 farmers attended these meetings, some walking several miles on snowshoes.

In Connecticut considerable progress was made in demonstrating the feasibility of clearing bowlders from fields with the aid of explosives.

FARM MACHINERY

The tractor or gas-engine school was practically the only form of extension activity in farm machinery during 1923. However, much information useful in the care and repair of farm machinery was given to farmers at such schools. The following report from California describes their one- and two-day tractor schools:

> No set demonstration lectures were given, but as the repair work progressed the specialist discussed informally the common troubles and the methods of repair usually followed. It was found impracticable in the time allowed to overhaul any tractor completely. The work consisted of valve grinding, bearing adjustment, attending to ignition and carburetor trouble, and minor repairs. Much time was spent in demonstrating the disastrous effects of dust on the tractor mechanism and the method that can be followed to reduce such trouble. The matter of lubrication was always of keen interest and justified considerable emphasis.

The extension service in New York has established sewing-machine schools for the benefit of farm women. Such schools were conducted along the same general lines as the gas-engine school, except that they were limited to one day. It was found from a survey that nearly 90 per cent of the sewing machines in use needed adjustment. The women brought their own machines to such schools. The first part of the sessions was devoted to cleaning and oiling the machines and the second part to a discussion of how to make adjustments to prevent the machines from skipping stitches or breaking needles. Instruction was also given in the use of attachments. After this the women made samples of stitches with their machines on different kinds of material, which they showed to the instructor and explained what they thought was wrong, basing their criticism on the information just received. They then made the necessary adjustments.

TEACHING METHODS AND RESULTS

A number of methods were employed by extension specialists in teaching agricultural engineering to farmers and in aiding them in making practical application of the knowledge that they acquired. These methods may be grouped roughly into three classes: (1) Distribution of printed matter, such as bulletins, plans, form letters, and posters, (2) lectures, and (3) demonstrations at farms, at schools, or at fairs.

Agricultural engineering covers such a wide range of subjects that it can not be said that any one of the above methods was preferred to another. Although the demonstration method proved effective in land clearing and terracing, the distribution of standard plans also brought widespread results in the construction of poultry houses, silos, and septic tanks. A combination of two or more methods is generally advisable.

Unquestionably, more attention should have been given to following up the results of the teaching, whatever the method employed. Some extension divisions have measured their results in terms of the number of meetings or

demonstrations held and the number of farmers attending rather than by later accomplishments of the farmers, such as the area of land drained or terraced, the number installing modern plumbing, electric lights, or approved barn-ventilation systems, or other results leading to a more satisfactory and contented farm and home life. It might be argued that when these matters have been brought to the attention of the farmer in the most forceful manner possible the responsibility for carrying out the ideas rests upon the farmer. Although this is undoubtedly true, the only way to determine whether the teaching methods followed are the most effective is by ascertaining what percentage of farmers reached put into practice the information that they received. Some States have realized the importance of this matter. The agricultural engineer of a western State extension division sent a formal letter to all farmers to whom plans had been sent for a home water system, inclosing an addressed postal card containing the following questions:

(1) Have you installed a water system?
(2) When do you expect to?
(3) Did the plans help you?
(4) How do you like the new system?
(5) Have you built a septic tank?
(6) When do you expect to?
(7) If built, what did it cost for material? For labor?
(8) Are you glad you have it?

The replies indicated that 11 water systems had been installed and 15 more were to be built soon, and that 21 septic tanks had been put in, and 16 more were to be installed.

Visual instruction, such as field demonstrations, models, motion and still pictures, and blackboard work, proved more effective than any other method. Well-planned exhibits at county and State fairs attracted the attention of many, but it was practically impossible to determine what actual results followed.

A movement recently started in Oklahoma which gives promise of good results consists in organizing farm-engineering clubs composed of boys between the ages of 16 and 21 years. The boys were required to buy levels (one level for two boys). They were given a two-day course in the use of the instruments and were then taken to a field and instructed in running level lines for terraces and drainage ditches, laying out ponds, and adjusting levels. A county club was limited to six boys a year, who worked under supervision of the county agent. At the end of the year they were required to enter a contest, the winners to be given a trip to the State fair. It was found that, as soon as the boys learned the proper use of leveling instruments, they engaged work in the neighborhood in laying out terraces and doing similar jobs not requiring special engineering knowledge.

The most potent force operating to induce farmers to follow the teachings of agricultural engineers has been the beneficial results following the adoption of improved practices in terms of increased revenue, greater comfort, or the saving of labor. In fact, a demonstration is not complete until it has been put to a practical test. When a farmer who has constructed terraces harvests a good crop of corn, while his neighbors obtain only half a crop because of soil washing, terracing immediately becomes popular in that community. For this reason great care should be exercised in selecting for such demonstrations farms that are accessible to the greatest number of farmers possible and that afford striking examples of the benefits which follow from the improvement. In like manner, a farm home which has installed modern plumbing according to approved plans becomes a permanent demonstration of the benefits of such improvements.

"Drives" or campaigns have proved excellent agencies for inducing farmers to adopt improved practices. A good example is the paint campaign, already described, that was conducted in a county of North Carolina. Concentration on one thing for a brief time has often accomplished more than years of patient teaching.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

May 22, 1925

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